

GEOGRAPHICAL DISTRIBUTION AND VARIATION
OF THE GENUS ARGYNNIS
III. ARGYNNIS DIANA

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THE DIANA FRITILLARY, *Argynnis diana* Cramer, departs from the most usual color pattern for the genus as the pattern is developed in most species of the Nearctic and the Palearctic. The male and female both have the basal two-thirds of the wings a brownish black. This distribution of pigment is in part the reverse of the distribution for *Argynnis idalia*, in which the black pigment is primarily restricted to the outer half of the wings. It has already been pointed out (Hovanitz, 1963) that the distribution of this pigment for *idalia* is diametrically opposed to the ordinary tendencies in other members of the genus in which the black pigment is normally distributed in the area of the basal regions. This is the pattern arrangement for *Argynnis diana*, *A. cybele*, *A. leto*, *A. nokomis* and others in North America which show an extension of basal melanism. The remainder of the wings shows the usual pattern arrangement of black dots and black striping which is typical of the genus *Argynnis* in any part of the world. In the male, however, these black markings are greatly diminished and restricted in most cases, especially on the hind wing, so that the outer one-third of the wings on the upper side are nearly a solid brownish-orange color. On the female this restriction of the black does not occur. It is in fact greatly extended so that not only is the outer margin all black, but the black-veined stripes are wide and extend from the basal black to the margin, and the black dots are large and converge to form black stripes running nearly from the anal margin to the inner margin at least on the fore wing. The part of the wings then remaining that would normally be a brown color in *Argynnis* is an iridescent blue. On the face of it, the female *diana* is a black butterfly with marginal and submarginal rows of blue spots. This dimorphism of the sexes of *A. diana* is the greatest expression in North American *Argynnis* of this type of variation. It is, however, nearly duplicated by some races of *Argynnis nokomis*, to which it may be closely related (fig. 1).

The under side of the wings also shows a very different aspect than the usual *Argynnis* pattern. This alteration of the pattern is more than the usual general suffusion of color over the wing but effects the pattern

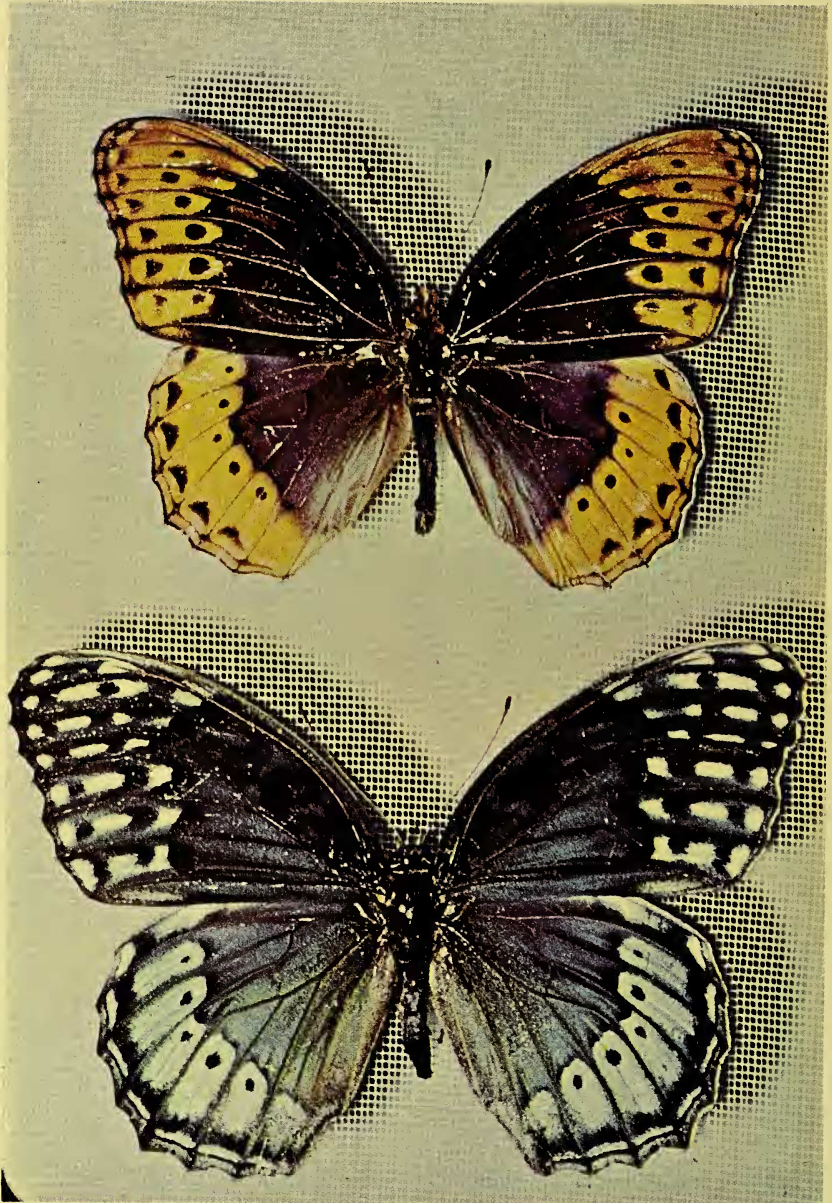


Fig. 1. *Argynnis diana*, upper side. Top, male; bottom, female. The blue is iridescent and may show only in certain directions of certain quality of light. (See fig. 2).

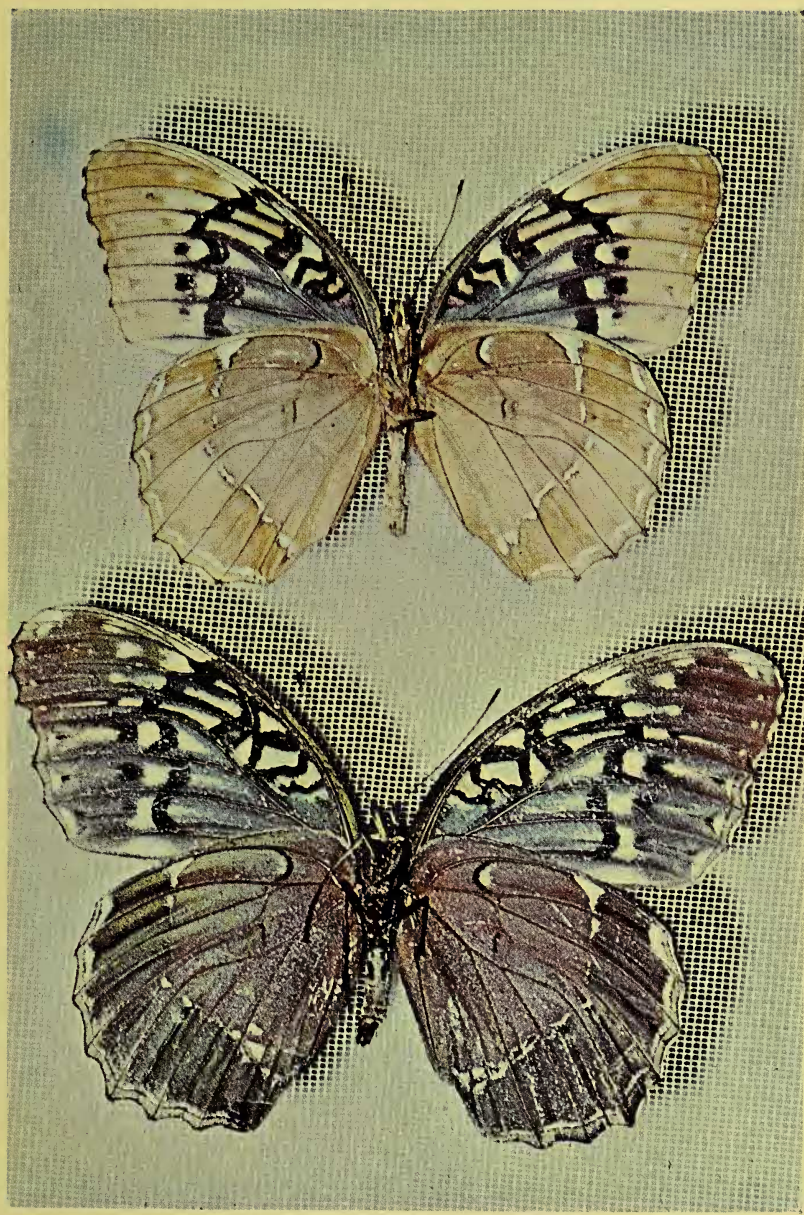


Fig. 2. Same as fig. 1, only under side. ♂ Salem, Roanoke Co., Virginia. June 13, 1937. C. W. Gottschalk. ♀ Montgomery Co., Virginia. Aug. 16, 1902. E. A. Smyth, Jr.

elements in such a way as to be most certainly of fundamental embryological nature. By this is meant the almost complete obliteration of the pattern elements on the underside of the hindwings in both the male and the female, with a slight degree of the same on the fore wings. In this development, *A. diana* is also most directly opposed to *A. idalia* in which the spots and pattern elements are well developed, even more so than in many other *Argynnis*. The pattern observed on the *diana* hind wing underside looks as though all markings had been wiped clean between the most marginal row of small spots and the usual *Argynnis* row of large silvery spots, substituting therefore, a uniform bluish black on the female, light brown in the male; likewise for the area from the base of the wing outward to the same row of spots nearly all markings of the usual *Argynnis* type appear to have been wiped clean except for a few minor points and substituting therefore a brownish-black on the female and light brown in the male. A small part of the central row of silvery spots of the usual *Argynnis* pattern remains, along with a small part of the cell spot and most marginal row in both the male and the female. The inner two-thirds of the fore wings on the under side in both sexes are similar to the usual *Argynnis* pattern. Interestingly enough, there is blue iridescence in this part of the wings of the male, even though the upper side of the male wings do not show it. (fig. 2)

A similar development of the pattern elements on the under side of *Argynnis* wings occurs in the groups related to *A. paphia*, *A. pandora*, *A. laodice*, *A. childreni*, etc. of Eurasia. These are the groups which have a distributional range through areas of higher rainfall, and thus more humid air, combined with higher summer temperatures. Some members of these groups also have a development of sexual dimorphism similar to that of *A. diana* and *A. nokomis*, even to the extent of having blue or bluish females while the male is the usual orange-brown color. More complete correlations between wing color, pattern type and insect size with climatic differences in various parts of the distributional range of *Argynnis* will come in a later issue.

The geographical distribution of *Argynnis diana* is a rather restricted one (fig. 3), hardly being more than 10° from the most northern part of its range to the most southern part and 15° from the most easterly to the most westerly part of its range. This area in miles is about 1000 miles from east to west and three to four hundred miles from north to south. Actually, the present known distributional range is shaped somewhat like a triangle, with an acute angle in the far west in Arkansas. Except for a collection in western Pennsylvania which may be inaccurate, the species is known only as far north as southern West Virginia and central Virginia. The most southern localities are southern South Carolina and northern Georgia and an area of north-central Arkansas. There are records of the species from southern Illinois. It is likely that they may be found in southern Missouri, southern



Fig. 3. Map showing the North American distribution of *Argynnis diana* and *A. nokomis*. Note the wide expanse of isolation between these two closely related butterflies; also the wide isolation between parts of the range of *A. nokomis*. Details on the geographical variation of *nokomis* will come in the next number in this series.

Indiana and southern Ohio in addition, though I have not seen specimens from these locations.

This species, despite its striking colors and size, is a relatively rare species due to the limited areas in which it lives. There is no evidence that at any time in the past the species was any less local than it is now, even though it is said that the deforestation of many parts of the east have contributed to its demise in many areas (Clark, 1951). The species exists in parts of North America away from the most heavily inhabited regions and therefore collectors have not had as much experience with it as with other species. Undoubtedly, the restricted habitat of the larvae contributes most to its own restricted range and the factors that are essential for larval environment are not known. Judging however from the habitats preferred by the adults and especially the females which is usually highly indicative, the species finds its home in areas of cold seepages and streams on the coastal plain, or in deep, damp, well wooded valleys or ravines, or on damp wooded mountain sides where there are cold streams (Clark, 1951). This corresponds to the habitat of *A. nokomis*, the western related species (fig. 1), which occurs in dry desert regions but only along cold streams where there is an abundance of boggy vegetation and locally a "wet-tropical" microhabitat as at Round Valley, Inyo County, California. This type of habitat is very local, not only in the desert regions of the west but also apparently in the east and is probably more responsible for the restriction of range of *diana* than the removal of the forest cover over extensive areas of the eastern parts of North America.

Clark (1951) gives the most complete description of the distribution, variation and habits of this species than has ever been given. The following is from his description:

"The first males to appear are smaller than those that emerge later, and the males from Highland County and from the higher latitudes in the mountains farther south are always small, resembling the earliest males from other regions.

"On the Coastal plain the males occasionally have on the under side of the hind wings at the end of the cell a conspicuous silver spot bordered inwardly and outwardly by black lines, corresponding to the silver spot in the same position in *S. cybele* though smaller, seldom reaching more than halfway across the cell, and the silver markings on the outer portion of the hind wings may be enlarged. Occasionally on the upper surface of the fore wings there are broad light dashes in the black ground color beyond the cell in the interspaces between veins 3 and 4, 4 and 5, 5 and 6, corresponding to the light dashes on the under side though with indefinite borders. So far as we have seen, these features are confined to males from the Coastal Virginia Plain. The majority of the males from the Coastal Plain, however, do not differ in any way from others from the mountains.

"Dr. Henry Skinner has pointed out that the males differ materially

in the number and size of the black spots on the upper surface of the hind wings. We have seen males, both from the Coastal Plain and the mountains, with the light border of the hind wings almost immaculate. There is some variations in the size of the black spots on the fore wings, and veins 2, 3, and 4, may be narrowly or rather broadly infuscated. The contrast between the dark basal and light outer portions of the under surface of the hind wings is sometimes accentuated. These variations seem to bear no relation to locality.

"Dr. Skinner said that females from eastern Tennessee, western North Carolina, and southern Illinois are larger than those found in Virginia; but the females from the lower altitudes in southwestern Virginia appear to be quite as large as any from farther south. Dr. Skinner pointed out that the females vary a great deal in the degree of silver beneath and also in the band of large bluish or greenish spots on the hind wings above. In some specimens these spots are large, and in others they are confined to a small area around the black spots. The number and size of the cream-colored or white spots on the upper side of the fore wings is also quite variable."

It appears from my own observations as well as from those of others that there is quite a lot of variability in this species; most of these variations however appear to be individual rather than population in scope, with the exception of those that are directly related to the elevation differences described by Clark. Occasionally the blue iridescence has been changed to green. Statistical study of large samples seems to be called for to bring this variation out of the realm of guesswork.

The species flies over a long season, males coming out in the middle of June and females slightly later with a height of emergence in the middle of August and extending into September.

Most authors in discussing this species in handbooks comment on mimicry between this species and some other species which inhabit the same general geographical area. Ehrlich (1961) states "The female presumably mimics the distasteful *Aristolochia* swallowtail, *Battus philenor*." Klots (1951) states "This is cited as a case of mimicry, the supposed model being the black and blue *Papilio philenor*, a swallowtail supposedly distasteful to birds." Scudder (1889) considers the female is a case of parastatic mimicry with *Basilarchia astyanax*. It is fortunate that most authors leave the case in doubt as most all situations of this sort are wild grasps at straws in the wind. The relationships in appearance of many butterflies in the same general geographical area, such as these three, *A. diana* in the east and *A. nokomis* in the southwest with *Papilio philenor* and *Basilarchia astyanax* are exceedingly interesting and deserve some intensive study. Too often these studies are superficial and involve some transference of a man's way of thinking to a butterfly or a bird. As purely a suggestion, it appears that a more satisfactory solution may be found in the physiological relationship of the butterfly with its physical environment, in which the colors are related in some

way to light reflection from the butterfly's wings (U.V. light perhaps) which reflections are developed in the butterflies living in a warmer or more humid environment.

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